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Article

Power interconnections in the Andean Community: what are the lessons in terms of price differences between Colombia–Ecuador and Colombia–Venezuela cross-border trading?

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ABSTRACT

Power interconnection is the process by which two or more countries, or two or more power markets within a country, decide to connect their power system in order to develop a partial or full power market, for competition, security of supply, facilitating trading, environmental or efficiency reasons. It has been part of the Andean Community agenda since 2002, with the Decision 536 of 2002, as one of its 12 strategic areas; under its rules, Colombia and Ecuador developed their power interconnection, with a power price per GWh cheaper than the price on the Colombia–Venezuela power interconnection, which is based on a Power Purchase Agreement. In order to reduce power prices from Colombian to Venezuela, to the current levels of Colombia–Ecuador cross-border trade, Colombia and Venezuela would sign an International Treaty that allow them to develop a power interconnection legal framework, with similar rules that those established in Colombia–Ecuador interconnection. It is important to take into account that the price reduction is based on the current conditions between the analysed power interconnections. Perhaps under other conditions the conclusion would be different, but the path is not ready in the AC for a cross-border free market.

1. INTRODUCTION

The electricity market is as complex as it is varied, and its design depends on the geographic and economic particularities of every country. It is true that every country needs electricity, and that every one of them will demand more power as their economies and population are growing.

Since the 1970s, academics and practitioners have been focused on different regulatory models on the power sector and in every part of the electricity market: generation, transmission, distribution, commercialization and metering. While many studies and much research focus on the generation side, particularly the need of different primary sources and adding more renewable sources to the generation mix, there are few focusing on the way of bringing the final product to the final consumer, plus the different and efficient ways to do so.

While big markets may benefit from a diversity of fuel sources that may help to drive down prices or compete for a share in the market, smaller or developing areas are left lagging behind. However, the electricity market has a tool that has not been widely used—due to technical or economic restrictions—yet could represent a major breakthrough if properly exploited. This is the interconnection between different markets, regions or countries.

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Transmission is a natural monopoly, as it needs networks. Different theories, from law, economy and policy, show that natural monopolies must be subjects of regulation, particularly in order to achieve the efficient use of the networks, freedom of access to transmission wires and competition. Nevertheless, transmission on lower tension levels or even at domestic levels is completely different from interconnections between different systems, regions or countries. In very simplified term, an interconnection is the feasible joining of different power systems. Section 2 below further explains the concept of interconnection and its intricacies.

Power interconnection or cross-border interconnection are the same from an international perspective, as happens in the European Union (EU).[1] They are an important part of the privatization, deregulation and/or liberalization processes. The objectives of interconnections vary, and include allowing for competition, security of supply and efficiency.[2] Interconnections can be important as they allow the creation of a 'larger energy market' instead of the development of domestic solutions, which normally are not enough vis-à-vis supplying the growing demand.[3]

All power interconnections are different, even between similar countries, or countries that are part of the same geographic region, and can be the result of bilateral or multilateral negotiations and agreements, including scenarios like the EU and the Andean Community. As an example, the South American country of Colombia has two interconnections: one with Venezuela and one with Ecuador. Even though all the countries are located in the same geographical area, the prices vary greatly between the price of the electricity sold to Venezuela and the price of the electricity sold to Ecuador, which is cheaper.

The purpose of this article is to study the basics of cross-border interconnections, from a legal point of view, and to engage in a case study with the aim of demonstrating how different power interconnection designs affect power prices. Thus, this article will focus on Colombia's two interconnections. Section 2 will discuss the definition of power interconnections and their main characteristics. Section 3 will analyse the development of the regulatory framework for interconnections in the AC. Section 4 will consider the peculiarities of the Colombia–Ecuador and Colombia–Venezuela interconnections, particularly in terms of the schemes used in every interconnection and their effect on prices.

2. POWER INTERCONNECTIONS

Definition

While it is difficult to give a definition of power interconnection, cross-border interconnection or regional integration, it is easy to describe why countries or regions decide to develop them.

Based on the descriptions and the purpose of the interconnection given in this article, one can propose the following definition: power interconnection is the process by which two or more countries, or two or more power markets within a country, decide to connect their power systems in order to develop a partial or full power market, for reasons of competition, security of supply, the environment, efficiency, or to facilitate trading.

Scholars have stated that the European Commission (EC) promoted investment in power interconnection with the aim of creating a properly functioning International Energy Market (IEM) in 2014 that would allow an increase in competition, trade and lower electricity prices, as well as expanding the use of renewable sources that require coordination between different national systems to develop their potential.[4] This is very similar to the definition proposed in the paragraph above.

1 cf Alex Jacottet, 'Cross-border Electricity Interconnections for a Well-Functioning EU Internal Electricity Market' Oxford Energy Comment <https://www.oxfordenergy.org/wpcms/wp-content/uploads/2012/06/Cross-border-electricity-interconnections.pdf> accessed 25 January 2016.

2 Camila Ochoa, Isaac Dyner and Carlos J Franco, 'Simulating Power Integration in Latin America to Assess Challenges, Opportunities, and Threats' (2013) 61 Energy Policy 267, 267.

3 Mateo Ferrero, 'The Andean Electricity Market: A Competition Law Analysis' (2012) 36 William and Mary Environmental Law and Policy Review 769, 778.

4 Jacottet (n 1) 1.

Characteristics

There are three main reasons to interconnect: '(1) emergency support, (2) savings on operating costs as a result of the structural differences of load profiles, and (3) savings in investment (and operating) costs from complementary means of production'.[5]

Currently several types of interconnected exchange exist: firm energy sales, backup exchanges for energy support, marginal exchanges of spinning reserves, occasional exchanges and compensation exchanges made in kind.[6] Nevertheless, 'no standard model of electricity export contract has yet been developed' and 'there still is no electricity "trade" in the full sense of that term'.[7]

Perhaps the main reasons for developing a power interconnection are:

- Security of supply: As pointed out, "the fact that a lower amount of generation reserve is required to maintain a given level of supply reliability constitutes a first economic benefit of integration. Secondly, it is easy to show in a simple two-node network that under the assumption of perfect competition, integrating electricity markets that were previously isolated increases total surplus—as long as the load can be supplied with cheaper generation. Finally, inadequate transmission capacity can isolate electricity markets and limit the number of generators competing to supply local consumers: integration is expected to mitigate local market power, by decreasing market concentration".[8]
- A gradual process of free market integration: As has happened in the EU, cross-border trading is the result of regulatory processes that reflect the principles of the economic community, through the creation of an IEM.[9]
- Reduced prices: Power interconnection creates new integrated and international markets, which allow for the allocation of lower costs from the cheapest supplies, principally in terms of power generation.[10]
- Efficiency in the generation source: This is not exclusively from prices. It is also applicable to the use of natural resources in generation, as well as 'generation technologies and resource availability in each country'.[11]

What can be obtained by the analysis of these reasons is that developing a proper power interconnection involves issues related to transmission and generation.[12] These characteristics and objectives were recognized by the AC in Decisions 536 of 2002,[13] 720 of 2009,[14] 757 of 2011[15] and 789 of 2013.[16]

In addition, some conditions for developing international power trade are required, including: the need and willingness of the parties; harmonization of power sector structures and regulation; regulation of transit rights and pooling arrangements as well as some technical issues regarding the transmission system in each

5 J Charpentier and K Schenk, 'International Power Interconnections: Moving from Electricity Exchange to Competitive Trade' (1995) Note 42 Public Policy for the Private Sector 1, 1.

6 ibid 2.

7 ibid.

8 Anna Creti, Elena Fumagalli and Eileen Fumagalli, 'Integration of Electricity Markets in Europe: Relevant Issues for Italy' (2010) 38 Energy Policy 6966, 6967.

9 cf Thomas Gruber, 'Cross-Border Trade in Electricity and Gas. Obstacles to Effective Competition from a Regulatory Standpoint' (2007) 8 ERA Forum 417.

10 cf Charpentier and Schenk (n 5).

11 Ochoa, Dyner and Franco (n 2) 267.

12 ibid 268.

13 AC, *Decisión 536 - Marco General para la interconexión subregional de sistemas eléctricos e intercambio intracomunitario de electricidad* (2002).

14 AC, *Decisión 720 - Sobre la vigencia de la Decisión 536 'Marco General para la interconexión subregional de sistemas eléctricos e intercambio intracomunitario de electricidad'* (2009).

15 AC, *Decisión 757 - Sobre la Vigencia de la Decisión 536 'Marco General para la Interconexión Subregional de Sistemas Eléctricos e Intercambio Intracomunitario de Electricidad'* (2011).

16 AC, *Decisión 789 - Sobre la modificación de la Decisión 757, que determina la Vigencia de la Decisión 536 'Marco General para la Interconexión Subregional de Sistemas Eléctricos e Intercambio Intracomunitario de Electricidad'* (2013).

country[17]; and providing the path for power exchanges between countries or regional or supra-regional markets.[18]

It is important to take into account that 'in a framework that is more competitive than cooperative, prices based on marginal costs, profit-sharing or avoided costs are difficult to use because competitors will no longer be willing to declare all their pricing information as they do in exchange-based systems. Therefore, in an internationally competitive system, electricity pricing must be based on market bids, as in the British and Norwegian systems and in certain U.S. pools'.[19]

However, in addition to the statement above, the price and contractual mechanisms must also depend on the harmonization of power structures and regulation among the interconnected countries or systems, as well as in the way the interconnected systems decide to regulate congestion and the use of congestion revenues. This will be further developed below.

Obstacles: capacity and congestion

As previously explained, lack of capacity is one of the reasons that countries become merged into power interconnections yet at the same time, lack of transmission capacity is an obstacle to cross-border interconnection.

Power transmission is a natural monopoly, and its capacity (as the amount of power that a transmission line is able to conduct) is limited by technical or legal considerations; thus, 'congestion management rules therefore are essential for ensuring non-discriminatory capacity allocation'.[20] Besides congestion management rules, another issue that a power interconnection has to take into account is the congestion management method, which should be market based, requiring an auction that could be explicit (capacity) or implicit (capacity and energy).[21]

Congestion (as the excess of transactions across a transmission wire) could be contractual or physical. Their differences are:

- Contractual congestion is 'a situation where the level of firm capacity demand exceeds the technical capacity and where unused capacity exists', which is normally generated 'by the relevant transmission system operator or distribution system operator in order to fulfil energy supply contracts concluded before liberalisation. The beneficiary of such long-term capacity reservation is usually the affiliated generation or supply branch of the vertically-integrated undertaking'.[22]
- Physical congestion 'is characterised by a situation where demand for capacity exceeds the amount of available capacity. Unlike a contractual congestion, however, in this situation, unused capacity does not exist', and the only solution in this case is adding new capacity.[23]

Before congestion is eliminated, allowing the creation of a single interconnected cross-border power trade market,[24] it is important to bear in mind that congestions generate revenues or rents and that 'the very fact that these (congestion rents) still exist is itself evidence that there is a sub-optimal provision of interconnection'.[25]

17 cf Charpentier and Schenk (n 5).
18 cf Ochoa, Dyner and Franco (n 2).
19 Charpentier and Schenk (n 5) 4.
20 Gruber (n 9) 421.
21 ibid.
22 ibid 422.
23 ibid 423.
24 Ferrero (n 3) 797.
25 Jacottet (n 1) 5.

Although this will not be analysed in this article, the use of congestion revenues depends on the geographical and design characteristics of each interconnection. Nonetheless, it is important to point out that the EU has developed different rules for congestion revenues in Regulation 1228/2003, Article 6, which allows the use of congestion rents for 'guaranteeing actual availability', 'network investments maintaining or increasing interconnection capacities' and 'as an income to be taken into account by regulatory authorities when approving the methodology for calculating network tariffs and/or in assessing whether tariffs should be modified'.[26] The case of the AC will be analysed further in Section 3.

The EU Regulation has received some criticism, such as 'it has also been stressed that the current regulatory framework does not ensure that congestion revenues are used for transmission investments that are in the long run beneficial to the market, because regulators are biased towards a short-term tariff reduction'.[27]

3. POWER INTERCONNECTION IN THE AC

In the case of the AC, energy integration is one of the 12 strategic areas for the AC.[28] It is important to take into account that according to Decision 608 of 2005, which is the general framework of the AC, the general objectives of the AC are promoting free competition, market efficiency and consumer welfare.[29]

Since 2002, the AC has regulated power interconnections among its members. From that point until 2006, the AC was integrated by Bolivia, Colombia, Ecuador, Peru and Venezuela.[30] Nowadays, Venezuela is not part of the AC, thus rules contained in Decision 536 of 2002 and in those that reform or replace it are not applicable to that country.

Under the AC Rules, there are two power interconnections: one between Colombia and Ecuador and the second between Ecuador and Peru.[31]

Decision 536 of 2002

In December 2002, the AC adopted Decision 536, 'General Framework for the Sub regional Interconnection of Electric Power Systems and intra-Community Electricity Exchanges',[32] which sought to enhance International Electricity Transactions (IETs), and its rules were[33]:

> a) "intra-communitarian trade in energy will not be restricted by price discrimination between national and foreign markets, subsidies, tariffs, or any other kind of restrictions; b) non-discriminatory access to international interconnected lines is guaranteed; c) free contracting is allowed among the electricity market agents; d) short-term IETs are permitted and should only be limited by the capacity of the international links; e) revenue that may arise from congestion at the interconnection link shall not be credited to the owner of such interconnection link; and f) Member States will ensure competitive conditions in the electricity market with prices reflecting economic efficiency, and will avoid discriminatory practices and abuse of dominance".

26 European Parliament and Council of the EU, Regulation (EC) 1228/2003 on conditions for access to the network for cross-border exchanges in electricity (2003) 4–5.

27 Leonardo Meeus and others, 'Regulated Cross-border Transmission Investment in Europe' (2006) 16 European Transactions on Electrical Power 591, 6.

28 AC, 'Energy and Electrict Power Integration' <http://www.comunidadandina.org/en/Seccion.aspx?id=71&tipo=TE&title=energy> accessed 25 January 2016.

29 Ferrero (n 3) 785.

30 AC, 'Brief History' (no date) <http://www.comunidadandina.org/ingles/quienes/brief.htm> accessed 25 January 2016.

31 AC (n 28).

32 ibid.

33 Ferrero (n 3) 788.

Two articles of this decision must be highlighted:

- According to Article 1.10, congestion revenues will not be allocated to the owners of the cross-border link.[34]
- 'Article 19 of Decision 536 exhorts Member States to make the necessary changes in their legislation to promote harmonization of the rules governing international interconnections and IETs'.[35]

It is important to note that the congestion rents had no destination to increasing interconnection capacities, as happens in the EU under Regulation 1228/2003.[36]

This decision, then modified through Decisions 720 of 2009 and 757 of 2011, was the basis for Colombia and Ecuador's power interconnection in 2003.[37] In order to develop it, both countries had to harmonize their power regulation, which will be analysed later in Section 4.

Decisions 720 of 2009, 757 of 2011 and 789 of 2013

Decision 536 of 2002 had its first suspension through Decision 720 of 2009, which ordered a new community regime for cross-border power trading among the AC, and it adopted a transitional regime for power interconnections developed under Decision 536 of 2002.[38]

It is important to underline that Decision 720 of 2009 introduced new rules to the power interconnection between Colombia and Ecuador: (i) agreements for cross-border trade are just commercial and they do not influence the economic dispatch of the systems; and (ii) congestion revenues will be allocated equally for each system.[39]

In 2011, Decision 757 ratified the suspension of Decision 536 of 2002 for two more years, and introduced a new transitory regime for both interconnections within the AC.[40] Its rules are similar to Decision 536 with modifications made by Decision 720.[41]

A similar situation occurred with Decision 789 of 2013, which suspended Decision 536 until 31 August 2016.[42]

Hence, with the changes made to congestion revenues, rules contained in Decision 536 of 2002 are still the legal framework for Colombia and Ecuador's power interconnection.

Current power interconnection project: the Andean Electrical Interconnection System

In 2011, the Ministries and Vice Ministries of Energy of Chile, Colombia, Ecuador and Peru signed the Declaration of Santiago, in which they created the Andean Electrical Interconnection System (hereafter SINEA, for its Spanish name), with the following purpose: 'the Working Groups of CAN related to planning and regulatory harmonization would participate in the SINEA, in order to provide them with the technical and normative support necessary for the regional electrical integration process. The SINEA also follows the principles of: (i) legal and contractual stability, (ii) freedom of transit, (iii) free access to the remaining capacity of the transmission lines, (iv) non-discrimination, (v) competitive pricing, and (vi) sustainable development'.[43]

34 AC (n 13).
35 Ferrero (n 3) 791.
36 cf European Parliament and Council of the EU (n 26).
37 AC (n 28).
38 Federation of Industries of the State of São Paulo, 'The Regulation of the International Energy Trade: Fuels and Electricity' (2013) 379 <http://www.fiesp.com.br/indices-pesquisas-e-publicacoes/the-regulation-of-the-international-energy-trade/> accessed 25 January 2016.
39 AC, *Decisión 720 - Sobre la vigencia de la Decisión 536 'Marco General para la interconexión subregional de sistemas eléctricos e intercambio intracomunitario de electricidad', 2–3.*
40 cf AC (n 15).
41 Federation of Industries of the State of São Paulo (n 38) 379–80.
42 cf AC (n 16); Federation of Industries of the State of São Paulo, ibid 380.
43 ibid 381.

To date, this initiative is still a project, and it has not yet affected the AC decisions discussed above.

4. COLOMBIA–ECUADOR AND COLOMBIA–VENEZUELA INTERCONNECTIONS

Power interconnections between Colombia–Ecuador and Colombia–Venezuela have different backgrounds. As will be developed below, while Colombia and Ecuador have developed their cross-border interconnection under the AC Decision 536, the Colombia and Venezuela interconnection is the result of agreements signed between ISAGEN (Colombia) and CORPOELEC (Venezuela).

Regardless of the contract details, and assuming that it is a Power Purchase Agreement (PPA), it is important to compare the prices between Colombia–Ecuador and Colombia–Venezuela cross-border trades. Assuming an exchange rate of Colombian Peso 1806.08 for 1 US dollar (USD) in 2012,[44] the comparison between both interconnections, in terms of price and electricity traded, are shown in Table 1 (Sources: The authors' elaboration based on information found in the Ministry of Mines and Energy of Colombia[45] and ISAGEN.[46]).

According to these data, the price of every GWh to Ecuador was USD 102,334.32. In contrast, the price of every GWh to Venezuela was USD 148,549.47, which is considerably higher.

What is the explanation for these price differences? Does the cross-border trade mechanism make some difference? Is it based on monopolistic behaviour from ISAGEN?

Colombia–Ecuador

The power interconnection between Colombia and Ecuador can be described as follows[47]:

> Since 1th [*sic*] of March 2003 Colombia and Ecuador have integrated their electricity markets through a scheme based on bids at the border nodes. These transactions are called TIE. TIE are hourly based interchanges, accomplished every day, as a result of market conditions which at the end determine the direction of the power flow through the line. Consequently, the interchange flows from the system with lower prices toward the system with higher prices.

This power interconnection is developed 'through two lines already installed one of 138 kV, operating independently and the other 230 kV operating on a synchronised basis. The maximum transmission capacity through these lines is 35 MW and 250 MW, respectively'.[48]

It is important to take into account that 'the grid connection between Colombia and Ecuador represents an example of positive economic externalities from electricity trade. In financial terms, Colombia receives US$115 million per year for conduit of electricity services to Ecuador, which saves around US$70 in production and distribution costs'.[49]

44 According to Oanda's Historical Exchange Rates tool <http://www.oanda.com/currency/historical-rates/> accessed 25 January 2016.

45 Ministry of Mines and Energy of Colombia, 'Memorias al Congreso de la República 2012 – 2013' (2013) 117 <http://www.minminas.gov.co/minminas/downloads/UserFiles/File/Memorias/Memorias_2013/4-Energia.pdf> accessed 25 January 2016.

46 ISAGEN, 'Informe Financiero - Diciembre 2012' (2012) <http://www.isagen.com.co/comunicados/Informe_financiero4_2012.pdf> accessed 25 January 2016.

47 William Amador, Silvia Cossio and A Pablo H Corredor A, *Transmission, Operation and Congestion Management in the Colombian Electricity Market* (IEEE 2004) 1300.

48 Pierre Gadonneix and others, 'Regional energy integration in Latin America and the Caribbean' 78 <https://www.worldenergy.org/wp-content/uploads/2012/10/PUB_Regional_Energy_Integration_in_Latin_America_and_The_Caribbean_2008_WEC.pdf> accessed 25 January 2016.

49 Francisco J Burgos, 'Regional Electricity Cooperation and Integration in the Americas: Potential Environmental, Social and Economic Benefits. Report to the Department of Sustainable Development Organization of the American States' 17 <http://www.oas.org/usde/reia/Documents/Regional%20Electricity%20Cooperation%20and%20Integration%20in%20the%20Americas.pdf> accessed 25 January 2016.

Table 1. Price comparison between Colombia–Ecuador and Colombia–Venezuela cross-border trades

Exports	*Total GWH in 2012*	*Total price (in USD 2012)*	*Congestion revenues (in USD 2012)*
To Ecuador	236	24,150,900.00	290,600.00
To Venezuela	478.4	71,066,065.73	NA

Process to develop the interconnection

This interconnection is based on Decision 536 of 2002,[50] which, in its Article 19, orders the harmonization of Colombia and Ecuador's legal and regulatory framework regarding power interconnections and cross-border transactions.[51]

In the case of Colombia, this process generated Resolution CREG 004 of 2003 (issued by the Comisión de Regulación de Energía y Gas, hereafter CREG), which is the Colombian regulatory framework for IETs.[52] In Ecuador, the harmonization was completed by Resolution 0002 of 2003, issued by the Consejo Nacional de Electricidad, the Ecuadorian regulator; then, both countries had to implement a coordinated operation scheme.[53]

It must be pointed out that Resolution CREG 004 of 2003, in its Article 31, assigned congestion revenues to domestic demand, reducing restrictions that are transferred from suppliers to consumers.[54] This destination of congestion rents was changed by AC Decision 720 of 2009.

It is important to keep in mind that, as a result of the normative and regulatory harmonization process, Colombia and Ecuador have similar power regulation and structures,[55] even though Ecuador, based on its economic model orientation, is reversing some of the privatization and liberalization reforms.[56] Nevertheless, as was pointed out above, this power interconnector has worked since 2003.[57]

50 ibid 7.

51 cf AC (n 13).

52 Comisión de Regulación de Energía y Gas de Colombia, *Resolución No 004 - Por la cual se establece la regulación aplicable a las Transacciones Internacionales de Electricidad de Corto Plazo –TIE-, la cual será parte del Reglamento de Operación, y se adoptan otras disposiciones complementarias* (2003).

53 Ferrero (n 3) 782–83.

54 Comisión de Regulación de Energía y Gas de Colombia (n 52).

55 'The Ecuadorian electricity sector was reformed in the second half of the nineties to replace a structure centred on companies that controlled total electric power activity. These reforms gave rise to a system based on competition with benefits to clients by providing improved prices and services. The most important change took place in October 1996, with the establishment of the Electricity Sector System Act (LRSE) where electricity sector activities were divided into three components: generation, transmission and distribution. A Wholesale Electricity Market was created. However, the main actors in the Ecuadorian electricity system are still the state-owned companies, at present constituted as limited companies. Although LRSE established free access to the distribution and transmission systems, it also gave a legal monopoly of transmission in Ecuador at a national level to the state-owned Transelectric S.A. . . The National Centre for Energy Control (CENACE), integrated as generation, transmission and distribution companies and major consumers, is responsible for technical and economic management of energy through the National Interconnected System in order to guarantee precise operation. It is also responsible for the administration of transactions in the Wholesale Energy Market'. [Gadonneix and others (n 48) 46]

The Colombian electricity market, after the 1990s reforms, can be described as follow:

> 'During the fifties, the Colombian Electricity Market became completely state-owned. This situation continued until the beginning of the nineties when there was electric power rationing throughout the whole country. This was caused by administrative, operational and financial deficiencies in the electricity companies operations, which had accumulated over the years. At that point, a restructuring process began in the Colombian electric sector. The first decree to this end (Decree No. 700) was issued at the beginning of 1992. Among other measures, it defined the rules for the entry of private investors into the generation activity. In 1994, a new regulatory framework for the sector was promulgated through the Electricity Act which introduced free competition in the sector and imposed limits to the vertical integration of the electricity companies. Trading was incorporated in generation, transmission and distribution operations, giving rise to a wholesale electricity market'. (ibid 45)

56 Ochoa, Dyner and Franco (n 2) 268.

57 Ministry of Mines and Energy of Colombia (n 45).

Regulatory decisions over congestion revenues: its possible effect over new interconnectors

As discussed, neither Decision 536 of 2002 nor the Colombian and Ecuadorian regulators decided to use congestion revenues for the expansion of their power interconnection. A different decision would have generated a completely interconnected market without putting power prices at risk, based on the design of the legal framework for cross-border power trading in the Andean area.

It is important to bear in mind that 'when congestion is fully eliminated, energy markets will merge to create a truly single zone with one price and shared liquidity'.[58]

In order to achieve this outcome, scholars have proposed the use of congestion revenues or rents to enhance or upgrade the interconnection network or its capacity, based on the rules of the EU Regulation 1228/2003.[59] This must be analysed for the SINEA, because 'in order to develop a more efficient common market and to exploit the complementarities of the region, interconnection capacities need to be expanded'.[60]

It is important to underline that at least in the Colombia–Ecuador interconnection neither the generator nor the transmitter are the owner of congestion revenue that is reallocated to the internal market in equal proportions.

Colombia–Venezuela

Cross-border interconnection with Ecuador is not the only electricity interconnection involving Colombia with its neighbours. Colombia and Venezuela have two interconnections: Cuatricentenario–Cuestecitas (with a capacity of 150 MW) and El Corozo–San Mateo (with a capacity of 140 MW).[61]

It is important to keep in mind that this power interconnection is developed outside the AC Decision 536 framework, because Venezuela has not been part of the AC since 2006.[62]

Current situation

It is essential to highlight some issues vis-à-vis the Venezuelan electricity market, and the relationship between Colombia and Venezuela.

Regarding the first issue,[63]

> "The Venezuelan electricity sector has, since the end of the nineties begun a reform process which, however, did not result in a well-defined policy. Reforms began in September 1999, when the Electric Sector & Organisation Law (Law No. 36791) was passed and thus established the basis for the creation of the Wholesale Electric Market by segmenting and unbundling generation, transmission and distribution companies to guarantee free access to energy transport and distribution activities. In December 2001, this legislation was complemented by the Electricity Service Organisation Law which specified the creation of a National Electricity Commission (CNEE).
> . . . In 2007 Venezuelan Government, through a Decree, determined the nationalisation and reorganisation of the national electricity sector. The new law, although stipulating that the electricity sector is to be state-owned, does not alter regulations regarding energy generation, transmission, distribution and trade; these continue to be the subject of the Electricity Service Organisation Law. The government's intention is to concentrate the entire electricity sector in a new corporation, the Corporation Electrical Nacional S.A. (CORPORELEC) linked to the Ministry of Oil and Energy (MENPET)".

58 Ferrero (n 3) 797.

59 ibid 803.

60 Ochoa, Dyner and Franco (n 2) 271.

61 Ferrero (n 3) 784; Iniciativa para la Integración de la Infraestructura Regional Suramericana, 'Strengthening of the Cuatricentenario - Cuestecitas and El Corozo - San Mateo Interconnections' (2014) <http://www.iirsa.org/proyectos/detalle_proyecto.aspx?h=106> accessed 25 January 2016.

62 AC (n 30).

63 Gadonneix and others (n 48) 48.

Therefore, it is clear that the power markets in Colombia and Venezuela are completely different. Colombia has had a wholesale market since 1994, whereas Venezuela has returned to a governmental monopoly.

Furthermore, the Venezuela and Colombia political relationship has been very difficult since the presidency of Hugo Chavez, the worst period being from 2008 to 2010, when both countries almost went to war.[64]

When Juan Manuel Santos became President of Colombia in 2010, he started to explore a new era in the relationship with Venezuela. In this objective, both countries signed the 'Declaration of Principles' and the 'Declaration of Miraflores', in an attempt to stabilize the international relationship.[65]

As a result of these approaches between both governments, in June 2011, Colombia restarted the cross-border interconnection with Venezuela, through ISAGEN, based on the agreement signed in 1992 with EDELCA, a former Venezuelan company merged with CORPOELEC.[66] This renewal of the energy exchange has been the basis for the new agreements between ISAGEN and CORPOELEC regarding cross-border sales of energy.[67]

Hence, in contrast to the interconnection with Ecuador, these cross-border linkages work based on bilateral contracts between ISAGEN (Colombia) and CORPOELEC (Venezuela), estimating 30 GWH of transactions per month[68] and taking into account that the energy supply is paid in advance.[69] The bilateral agreement between ISAGEN and CORPOELEC has not been published by any of both the parties.

As a result of this information, one can assume and conclude the following:

- Capacity of the transmission line is reserved by ISAGEN, based on the PPA and its payment in advance. Therefore, the use of this power interconnector is blocked by ISAGEN, which neither allows the entry to other generators nor allows for the use of wholesale market rules, and System Operator, to form relationships with CORPOELEC and sell cheap electricity to Venezuela.
- ISAGEN is a mixed public utility company under the Colombian legal framework; its majority shareholder is the state, through the Ministry of Finance and Public Credit.[70] Power transmission to Venezuela and Ecuador is operated by ISA,[71] which is another mixed public company with the state as a majority shareholder.[72] Neither ISAGEN nor ISA are passive subjects in this transaction, as happens under Colombia–Ecuador power interconnection rules. One of them, either ISAGEN or ISA, keeps congestion revenues from Colombia–Venezuela power interconnection.

64 cf Maria Teresa Romero, *The Fragile, Back-and-Forth Relationship Between Venezuela and Colombia* (Real Instituto Elcano 2008) <http://www.realinstitutoelcano.org/wps/wcm/connect/1c44fe804f018b8fb963fd3170baead1/ARI40-2008_Romero_Venezuela_Colombia.pdf?MOD=AJPERES&CACHEID=1c44fe804f018b8fb963fd3170baead1> accessed 25 January 2016.

65 Ministry of Foreign Afairs of Colombia, 'High Level Meetings' (no date) <http://www.cancilleria.gov.co/en/international/politics/venezuela/encounters> accessed 25 January 2016.

66 Ministry of Mines and Energy of Colombia, 'La República de Colombia Respalda Abastecimiento Energético a Venezuela' (2011) <http://www.isagen.com.co/comunicados/Boletin_Informativo_COMUNICADO_Venezuela.pdf> accessed 25 January 2016.

67 ISAGEN, 'Colombia and Venezuela Renew the Binational Energy Agreement with ISAGEN's Energy Exports' (2012) <http://www.isagen.com.co/informacionRelevante/2012/Exportacion_energiaVenezuela_eng.pdf> accessed 25 January 2016.

68 ibid.

69 ISAGEN, 'March 2013 General Meeting Questions' (2013) 1 <http://www.isagen.com.co/comunicados/preguntas_ASAMBLEA_2013_EnCrEd.pdf> accessed 25 January 2016.

70 ISAGEN, 'Institutional Overview' (2013) 3 <http://www.isagen.com.co/comunicados/institutional_overview_2013_mayo27.pdf> accessed 25 January 2016.

71 ISA, 'Quiénes Somos - Transporte de Energía Eléctrica' (2016) <http://www.isa.co/es/isa-y-sus-negocios/Paginas/transporte-de-energia-electrica.aspx> accessed 25 January 2016.

72 ISA, 'Shareholder Structure' (2016) <http://www.isa.co/en/our-company/Pages/about-us/our-shareholders.aspx> accessed 25 January 2016.

- Based on this situation, it could be argued that in this power interconnection the important issue is not the use of the line, as in the Colombia–Ecuador case. It is to take the maximum price in cross-border trade to Venezuela, affected by the scheme defined by ISAGEN and CORPOELEC. This is reflected, for instance, in ISAGEN's 2012 financial report, in which the company underlines that 7 per cent of its operational incomes came from power exports to Venezuela.[73]

Perhaps these are the reasons for the difference in prices between the Colombia–Ecuador and Colombia–Venezuela power interconnections during 2012, as was shown above.

Possible solutions for decreasing prices to Colombia–Ecuador interconnection levels

From the Colombia–Ecuador interconnection experience, power prices in Colombia–Venezuela cross-border trade would be reduced if both countries agreed on some rules, similar to those contained in AC Decision 536 of 2002 and the subsequent. This should be developed through an International Treaty between the countries, since Venezuela is not part of the AC.

In particular, the public international law instrument proposed should take into account the following:

- Decisions 536 of 2002, 720 of 2009 and 789 of 2013 have some rules that allow free access to international interconnected lines. If Venezuela and Colombia decided to include similar rules, it would make a huge change to their power interconnection because the interconnection maximization would be guaranteed by allowing free contracting between the electricity market agents, as well as commercial cross-border trade that would not influence the economic dispatch of the systems.
- Congestion revenues could be used to increase interconnections between both countries, not to increase the profits of ISA and/or ISAGEN. If they do not want to use this rent to increase their cross-border trade, they must take the same or a similar decision that was taken by the AC in Decision 720 of 2009.
- Parties would take into account the way the price of power is determined under AC rules, reflecting economic efficiency, avoiding discriminatory practices and abuse of dominance. This method would generate the termination of the bilateral agreement between ISAGEN and CORPOELEC. However, this is very complicated under the Venezuelan current political situation. During the present century, Venezuela has suspended payments to Colombian suppliers several times in many economic areas. This debt has generated a number of meetings between public authorities from Colombian and Venezuela, without a final solution.[74] If Colombia and Venezuela do not design a mechanism for payment security of electricity trading through the interconnection, it is possible that Colombian generators will not be interested in selling their power to CORPOELEC.
- Perhaps the most important step that both countries have to take is to change their legislation to promote harmonization of the rules governing international interconnections. This sounds like it is complicated by the fact that Venezuela has a public monopoly organization, whereas Colombia has a wholesale market; but in practice, this would not be difficult because each party simply has to revise its legislation regarding cross-border interconnections, which would not require any changes to its domestic market structure.

Will future decisions affect prices?

It is important to take into account that the price reduction studied in this article is a conclusion that is based on the current conditions between the analysed power interconnections. Perhaps under other conditions the

73 ISAGEN (n 46).

74 Colombia Reports, 'Ministers from Colombia and Venezuela Meet to Discuss Bilateral Trade' (2013) <http://colombiareports.co/ministers-from-colombia-and-venezuela-meet-to-discuss-bilateral-trade/#> accessed 25 January 2016.

conclusion would be different, which was demonstrated in the paper 'Simulating power integration in Latin America to assess challenges, opportunities, and threats'.[75]

In this article, the authors analysed three different scenarios (self-sufficiency, taking advantage of opportunities and free market), finding that in a power interconnection among Colombia, Ecuador, Peru and Panama 'the last of these (scenarios) may bring more benefits in terms of supply costs, as it allows a better use of resources by taking advantage of complementarities between countries, if the right policies are in place. However, it also involves higher risks in case technical problems, political instability or other issues arise, causing interruptions to international transactions'.[76]

Although this scenario is hypothetical, the best way that Colombia and Venezuela could work on improving their cross-border scheme would be to repeat the same framework that Ecuador and Colombia developed for their power interconnection, because of its benefits in terms of power price and functionality.

5. CONCLUSIONS

Power interconnection is the process by which two or more countries, or two or more power markets within a country, decide to connect their power systems in order to develop a partial or full power market, for competition, security of supply, facilitating trading, environmental or efficiency reasons. It involves generation and transmission.

Interconnection is important for developing countries. A larger energy market means more supply sources, allocation of prices between efficient generators and efficiency in generation source, which contribute to reduce prices among interconnected systems.

The success of the cross-border interconnections depends on the transmission capacity, the congestion management method, as well as the use of congestion revenues or rents to increase interconnection capacities. It also includes price and contractual mechanisms, which are influenced by the harmonization of power structures and regulation among the interconnected countries or systems.

Power interconnection has been part of the AC agenda since 2002, with the Decision 536 of 2002, as one of its 12 strategic areas. Decisions 536 of 2002, 720 of 2009 and 757 of 2011 are the basis for Colombia and Ecuador's power interconnection. Under their rules, Colombia and Ecuador have found a power price per GWH that is cheaper than the price on the Colombia–Venezuela power interconnection, which is based on a PPA.

Colombia and Venezuela should sign an International Treaty to allow them to develop a power interconnection legal framework, with similar rules to those established in the Colombia–Ecuador interconnection. This could reduce power prices from Colombia to Venezuela, to the current levels of Colombia–Ecuador cross-border trade.

It is important to take into account that the price reduction studied in this article is a conclusion that is based in the current conditions between the analysed power interconnections. Perhaps under other conditions the conclusion would be different, but the path is not ready in the AC for a cross-border free market.

It is also central to consider that the use of congestion revenues for increasing transmission capacity in the interconnection between Colombia and Ecuador would generate a completely interconnected market without putting at risk power prices, based on the design of the legal framework for cross-border power trading in the Andean area.

The conclusions of this article, especially the use of congestion revenues for increasing interconnection transmission capacities, should be taken into account by the SINEA, in the development of its strategy to develop a power common market from Chile to Panama.

75 cf Ochoa, Dyner and Franco (n 2).

76 ibid 273.